

# Measuring the Neighborhood Benefits of Rail Transit Accessibility

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For many Americans, living near high-quality rail transit stations provides an array of benefits. The benefits arise from lower transportation expenses, changing development patterns, and other nonuse factors. Automobile-centered development patterns increase congestion, sprawl, and pollution. The benefits of transit-oriented neighborhoods are explored. A hedonic price function is used to estimate property values and the effect of proximity to rail transit stations. Geographical information system databases were used to calculate actual walking distances to transit, providing a much more accurate measure of the "proximity" variable than the usual measure of straight-line distance. The results indicate that proximity to rail transit stations can be a significant source of benefit to residents within walking distance. Whereas light rail transit stations in Portland, Oregon, indicate minimal effects, the magnitude of the benefits for the Bay Area Rapid Transit and New York City Metropolitan Transportation Authority stations, when compared with standard measures of transit benefits, indicate that benefits from transit exceed those attributable to transit use.

Growing traffic congestion and urban sprawl have led to a realization that communities designed only for automobiles hold disadvantages for residents who may be better served by rail transit. For these residents, transit access in neighborhoods may be increasingly valuable in terms of transportation benefits and the positive effects transit has on neighborhoods.

The literature suggests that transit plays a vital role in neighborhoods served by high-quality rail transit. The effects of transit include

- Lower transportation expenses,
- Higher property values, and
- Changes in development patterns.

Transportation and land use are intertwined, each influencing the development of the other. Providing high-quality transit together with development policies that allow or encourage transit-oriented development can influence land use patterns toward higher densities, better pedestrian environments, and mixed-use developments clustering around rail transit stations.

Current development patterns have a historical basis in terms of social preferences (often reacting to urban problems), technological change, and government policy decisions. These influences have caused sprawling development patterns using large amounts of formerly open space, ineffective transit access, increasing pollution, and high levels of congestion. These conditions and changing government policies suggest that new urban development paradigms may be emerging to address these issues. Modern urban problems may be addressed by encouraging the development of transit-oriented, higher-density, and mixed-use neighborhoods.

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The concept of neighborhood livability encompasses two main types of potential benefits. The first benefit category is resource savings, which encompasses items included in typical cost-benefit analyses such as reduced vehicle miles traveled, time savings, reduced vehicle operating costs, and the like. To the extent that consumers are aware of the resource savings, this value should be capitalized into property values around transit stations.

The second benefit category refers to benefits that are derived apart from the actual use of the transit system. The presence of transit contributes to the character and form of neighborhoods and creates opportunities whose value may not be fully captured by the intensity of use of the transit system. Not only does the proximity to transit enable opportunities for travel (and receiving visits), but transit stations themselves are frequently local commercial centers offering a range of commercial and neighborhood services in their vicinity. These neighborhood effects of transit may provide benefits to residents in addition to transit user benefits. To the extent that these benefits exist, property values will reflect residents' willingness to pay for them.

Hedonic methods estimate the value of transit to station area residents. The estimate will include both transportation benefits and any nonuse benefits of transit derived from neighborhood form and general livability. Currently, there is no sure way to separate these two effects. Therefore, counting the property value effect additively in a cost-benefit analysis would double count some of the benefits from transit. An attempt at disentangling these benefits is included with the results.

## HEDONIC METHODS

Hedonic price estimation is performed using multiple regression techniques where the change in property values is a function of community amenities (distance to transit stations) and other social and economic variables. The regression coefficients are then used to calculate the implicit marginal prices (or shadow prices) of the amenities.

This research used the hedonic approach, both because the method is well established in the literature and because Hickling Lewis Brod (HLB) has applied, with Criterion, Inc., a new method for quantifying model inputs. The approach makes use of geographical information system (GIS) techniques to measure, as accurately as possible, the walking distance to transit, the key variable in hedonic models of transit-oriented neighborhoods. Data for hedonic models can be gathered at relatively low cost, and calculation of walking distance to transit can be readily accomplished using GIS.

House values and property values are not mutually exclusive in the stated price; it is therefore necessary to control for structural characteristics that differ across the sample. A general hedonic

equation examines the relationship of a dependent variable with all of its related independent variables. If property value is the dependent variable, it is necessary to account for all variables that influence property value. Property values are influenced by land size, house size, neighborhood accessibility, neighborhood amenities, and population, to name a few. The model comprises all structural characteristics of the dependent variable, characteristics of the neighborhood and environment, characteristics of the amenity being analyzed, and an error term. The typical hedonic equation takes the following form:

$$P_h = P_h(S_i, N_i, Q_i) \quad (1)$$

where

- $S_i$  = structural characteristics of the property,
- $N_i$  = characteristics of the neighborhood/environment,
- $Q_i$  = location specific amenities, and
- $i$  = individual property at the  $i$ th location.

Coefficients may be defined in terms of elasticities or marginal implicit prices. A linear specification returns coefficients in terms of implicit marginal prices (shadow prices), whereas logarithmic specifications return coefficients in terms of elasticities. For example, if the coefficient of distance from a transit station location is 0.067, a 10 percent change in distance, all other things held constant, results in a 6.7 percent change in property value. Coefficients stated as marginal implicit prices explain absolute changes in the dependent variable (e.g., if a coefficient of distance from a transit station is  $-15$ , a one-unit increase in distance from transit results in a \$15 reduction in property values, on average).

## MEASURING DISTANCE IN TRANSIT ACCESS MODELS

The approach used in this study is derived from the literature of hedonic property value studies of transit station areas. Previous studies have focused primarily on large data sets spread across metropolitan areas. The San Francisco research by Landis et al. (1) used countywide data and measured property value effects over 30 km from Bay Area Rapid Transit (BART) stations. The research in this study takes a more local point of view, using a single station area within a 1.6-km (1-mi) radius of BART, New York Metropolitan Transportation Authority (MTA), and Portland MAX stations.

This research seeks to find neighborhood-level effects of transit access. The hypothesis of this research is that transit improves the livability of transit-oriented neighborhoods, producing benefits across the neighborhood, whether or not a particular resident uses transit. Finding a property value benefit with transit access, regardless of use, helps to confirm the notion of a neighborhood benefit apart from transit use. The property value premium represents a willingness to pay for transit proximity.

This approach uses data collected from real estate transactions and local government GIS data. Previous hedonic studies have used geographical distance to measure property value effects of transit access. The purpose of a housing hedonic study is to measure the effect of some property attribute on property value, resulting in an estimate of the willingness to pay for that attribute. The property attribute that must be measured in a transit access study is the actual walking distance to the transit station, holding all other attributes constant.

The typical solution to generating data on walking distance to transit is to use point-to-point, straight-line distance from each property parcel to the transit station. This measurement is typically made by simply assuming that residents can walk in a straight line from their home to transit. This is never a truly accurate estimate of walking distance because streets do not always lead directly from one point to another. Some streets curve, meander, or dead-end, whereas other streets are cul-de-sacs that do not allow access at the shortest distance between points. Studies that use geographical distance to approximate walking distance to transit will miss some significant variations between properties. Some properties that are physically closer to a transit station than another property may be several minutes further away by actual walking distance, depending on the efficiency of the street grid.

The use of a GIS is a major innovation over the typical hedonic methodology applied to transit station areas, both in accuracy and in cost. GIS allows the precise measurement of the most important variable in the hedonic equation—actual walking distance to the transit station. HLB employed Criterion, Inc., an urban planning firm, to generate actual walking distances from parcels to transit and to map the results on a property-by-property basis. The GIS contains detailed information concerning the street grid in a given area and specifies each property parcel within the area in question. By calculating the shortest street distance from each parcel to the transit station, detailed data on the true variable of interest, walking distance to transit, are accurately specified. This methodology improves the ease and quality of analysis for hedonic property value studies involving access.

Several previous studies used actual walking distance to transit in hedonic models. However, these studies have been time-consuming and expensive since walking distance had to be measured by “hand”—either by measuring the street distance on a map or by actually walking the route and recording the measured distance. GIS software makes this calculation a transparent exercise. All that is needed to replicate the methodology presented here is a GIS database that includes geocoded property parcels and a real estate database that includes property characteristics and matching geocodes for the property parcels. Using standard GIS software and some specialized GIS manipulation products (in this case, provided by Criterion, Inc.), distances are calculated for each property. Multiple regression techniques are applied to the databases, producing estimates for the effect of transit proximity (measured by walking distance) on property values.

## STUDY AREAS

### San Francisco—BART Study Area

The study area radiates from the Pleasant Hill BART station along the Yellow line. This station area is well outside of San Francisco proper, lying east of Berkeley in a suburb of low to moderate density within Contra Costa County. The neighborhood is made up mostly of single-family homes with some office, shopping, and multifamily residential development closer to the station. The area is made up of middle- to high-income residents at nearly \$60,000 per household. Average home values in the station area are nearly \$250,000.

This station is well established, having opened in 1973, suggesting that nearby residents should be well accustomed to the available transit options. Property values in the area should have fully

adjusted to reflect the neighborhood development effects and transportation benefits from BART service.

The area of transit effect is assumed to be approximately 1.6 km (1 mi) from the Pleasant Hill BART station. This area is consistent with findings in previous studies (2). Whereas other studies have found property value effects beyond this radius (1), this study seeks to focus on station area effects, which correspond to walking (or biking) distance to transit. The literature indicates that most station area residents will not be willing to walk much more than 0.8 km (0.5 mi) to transit. For this reason, areas within 1.6 km (1 mi) of the BART station should encompass the areas most likely to show changes in neighborhood structure that facilitate transit-oriented development.

There were two primary data sources for the Pleasant Hill study area. Contra Costa County provided GIS mapping data, which allowed the calculation of walking distances from each parcel to the Pleasant Hill station. Home sale price data were purchased and matched to parcel numbers in the GIS database.

Home sale price data were collected for every property sale between 1976 and the first few months of 1996 within a 1.6-km (1-mi) radius of the transit station. Only sales from 1984 to 1996 were included in the regression because of unusual sale price activity between 1979 and 1983, a period of acute economic instability. Sale prices were expressed in constant 1995 dollars in the regression analysis.

### New York City—Queens Study Area

Decidedly more urban than the other study areas, the Queens study area focused on three New York City MTA subway stations: Forest Hills, 67 Avenue, and Rego Park, which are all within the neighborhoods of Forest Hills and Rego Park.

These stations fall along the E, F, and R lines (which travel to uptown Manhattan before splitting off to downtown, Harlem, and the Bronx) and the G line (which travels to downtown Brooklyn). Forest Hills is served by all four lines, whereas the other stations are served by the G and R lines.

Whereas the New York City subway system is much older than the other systems in this study, the scope and mobility offered by the system is unmatched in the United States. New York City neighborhoods warrant detailed study by virtue of their transit dependence. If mobility on the transit system provides benefits to residents, these station areas should display strong property value effects by virtue of superior access.

Forest Hills is the highest-priced neighborhood in the study, with average home values around \$390,000. The homes nearest 67 Avenue are less costly at about \$226,000, and Rego Park is the lowest at just under \$200,000. Household income is also highest in Forest Hills at nearly \$60,000 followed by 67 Avenue at about \$50,000 and Rego Park at about \$44,000 per household.

Data for the New York study were provided by the City Planning Office and TRW. The planning office provides GIS mapping data on CD-ROM for every borough in New York City. The real estate database from TRW provided sale prices for homes in the study area. The data were provided for every sale over the past 18 years and were expressed in constant 1996 dollars. Data regarding home size and other physical characteristics were unavailable from TRW. The data limitation reduces the regression equation's explanatory power. Although not a completely satisfactory solution, other variables for median income and lot size aggregated by census district

were included in the regression. This approach provides additional information regarding socioeconomic factors and average home characteristics at the level of detail of a few blocks.

### Portland, Oregon—MAX Study Area

The analysis of Portland's MAX light rail station areas tested three stations along the East Burnside corridor: the 148th Avenue, 162nd Avenue, and 172nd Avenue stations. These three stations are less than 1.6 km (1 mi) apart, creating a heavily transit-served neighborhood. The light rail system in Portland primarily uses existing rights-of-way down major arterial streets.

Land use surrounding these stations is dominated by single-family detached, moderately priced homes, with relatively small amounts of multifamily residential and civic (schools and parks) buildings. The average home value in the station areas within 1.6 km of the three stations is about \$95,000.

The data for the Portland MAX study area were collected from city property tax rolls and a GIS database from the metropolitan planning agency (Metro) to calculate walking distance to the light rail stations. The database for this case study was extensive, including nearly every property within a 1.6-km radius of all three stations. In all, the regression equation contained data for more than 4,000 properties with precise data on the walking distance to the nearest transit station. The data for this analysis are a cross section for 1995.

## RESULTS: PROPERTY VALUES IN TRANSIT-ORIENTED NEIGHBORHOODS

### BART—Pleasant Hill Property Value Study

#### Model Specification

A hedonic model is used to isolate the effects of proximity to BART on property values near the Pleasant Hill station. The model is specified to include a mix of home characteristics and transportation characteristics to account for as much property price variation as possible.

Data on home characteristics include such items as number of bedrooms, number of bathrooms, size of the home in square feet, lot size, and age of the home. All of these variables are not included in the model because of multicollinearity. Tests of various regression equations indicated that home size, lot size, and age of the home accounted for most of the variation in home values due to home characteristics while avoiding problems of multicollinearity.

A concise summary of the traditional solutions to multicollinearity among explanatory variables is given by Maddala (3, pp. 190–194). The method used in this study is to drop variables that are the source of the multicollinearity and that do not add significantly to the explanatory power of the regression. The method of principal components is often suggested as a solution to the multicollinearity problem. However, as Maddala (3) notes, this methodology is of limited value for this purpose and is easily misused.

The best regression equation, which accounts for more than 80 percent of the variation in property values in the sample, has the following specification:

$$\text{HomeVal} = \alpha + \beta_1 \text{Dist\_to\_Bart} + \beta_2 \text{Dist\_to\_Hwy} + \beta_3 \text{HomeAge} + \beta_4 \text{HomeSize} + \text{error} \quad (2)$$



where

HomeVal = sale price in constant 1995 dollars,

$\alpha$  = regression constant,

Dist\_to\_Bart = walking distance from the home to the transit station (ft),

Dist\_to\_Hwy = physical distance from the home to the nearest freeway (ft),

HomeSize = size of the home (ft<sup>2</sup>), and

HomeAge = age of the home (years).

The primary coefficient of interest is  $\beta_1$ , which is the change in home value from a 0.3-m (1-ft) change in walking distance to the BART station. A positive coefficient means that transit has a negative effect on property value, whereas a negative number means transit proximity enhances property values. The hypothesis of this study, which is confirmed in the results (see Table 1), is that this coefficient will be negative and significant, indicating that transit access provides economic value that is capitalized in local property values.

The regression equation displays possible heteroskedasticity. The source appears to be high forecast errors for very expensive homes. To test this proposition, the regression equations were reestimated without the 31 properties that exceeded \$350,000. This regression did not fail White's heteroskedasticity test. The coefficient on the station proximity variable actually implied stronger property value effects, but the  $R^2$  and  $F$ -statistics worsened. As a final test, the original model was run using White's heteroskedasticity consistent covariance matrix (a form of weighted least squares that corrects for heteroskedasticity). This model did not change the coefficients or their significance in any appreciable way. All models in this paper were estimated using White's correction.

#### Analysis of BART Results

The regression results show that for homes in the study area, BART access is worth \$15.78 more for every 0.3 m (1 ft) closer to the sta-

tion on average. This means that an average home in the study area would be worth more than \$15,000 more if it were 305 m (1,000 ft) closer to BART than its original location. Interestingly, closeness to highways has a negative effect on housing values within the study area. The regression shows that homes further from a highway interchange are worth \$7.94 more on average for every 0.3 m (1 ft) further from the freeway interchange. The value of an average single-family home in the Pleasant Hill station area is nearly \$23,000 greater (9 percent premium) than comparable homes just outside the station area because of its proximity to BART.

The home characteristics variables are extremely good indicators of home values. Building size is the most important determinant of home prices with a value of about \$1,100/m<sup>2</sup> (\$100/ft<sup>2</sup>). Home age tends to reduce property values by about \$443/year. All explanatory variables in this regression are highly significant. Figure 1 shows how property values for two- and three-bedroom homes decay with distance from BART. The figure shows a good fit between predicted and actual values.

The logarithmic specification replicates the linear specification using natural logarithm transformations of the variables. The results show the same relationships expressed in the preceding regression but express them in terms of elasticities (see Table 1).

The interpretation of the coefficients is that the value equals the percentage change in home sale price given a 1 percent change in the independent variable. For example, a 1 percent increase in distance from BART results in a 0.22 percent reduction in home price. The interpretation of the other coefficients follows similarly. A 1 percent increase in distance from the highway leads to a 0.10 percent increase in home sale price. A 1 percent increase in home size leads to a 0.62 percent increase in sale price, whereas a 1 percent increase in home age leads to a 0.05 percent decrease in home sale price.

#### Evidence of Nonuse Values

The results of the Pleasant Hill area research confirm a large and significantly positive effect of access to BART on property values around the station. The effects reflect an array of benefits from transit access that this study cannot fully delineate. Some of the premium paid for proximity to transit compensates for the reduced travel costs. This compensation is measured by the benefit from trips actually taken.

However, there may be a nonuse benefit, which is evidenced in two ways. First, many people who live near transit are willing to pay a property value premium, yet they do not use transit. Second, the amount of the observed property value premiums is too large to be

TABLE 1 BART Regression Results with Linear and Log-Linear Specifications

Dependent Variable: Home Sale Price in 1995 Dollars	Linear Model	Log-Linear Model
Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Constant	143,504.9 (8.70)	9.04 (19.72)
<b>Home Characteristics</b>		
Age of Home	-422.79 (-2.48)	-0.05 (-3.34)
Size of Home	100.39 (21.14)	0.62 (18.19)
<b>Transportation Characteristics</b>		
Distance to BART	-15.78 (-5.79)	-0.22 (-5.63)
Distance to Highway	7.94 (3.15)	0.10 (3.61)
All coefficients are significant at the 1 percent level.		
<b>Summary Statistics</b>		
Number of Observations	263	263
$R^2$	.81	.77
Mean Dependent Variable	249,848.4	12.38
White Heteroskedasticity Test	2.36 (pr. = 0.0181)	2.63 (pr. = 0.0014)
F - Statistic	272.999	216.05

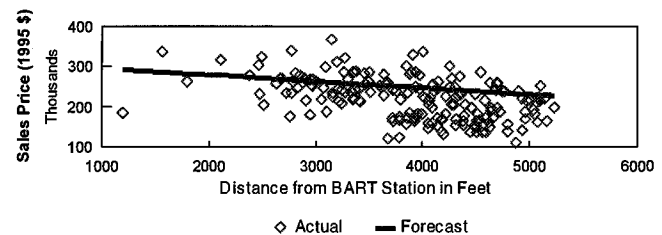


FIGURE 1 Property values and distance to BART, two- and three-bedroom homes (average home characteristics assumed) (1 ft = 0.3 m).

explained by user benefits. These are more fully discussed in the following paragraphs.

Consumers pay a premium regardless of transit use. Many individuals in the study area pay premiums in housing prices in excess of \$20,000 to live near transit but will never use transit. This willingness to pay the premium must reflect some value of transit proximity that accrues to residents regardless of transit use.

The value premium is too large to represent user benefits. To illustrate this point, consider the following scenario: two residents of the Pleasant Hill neighborhood are regular BART users who walk to the Pleasant Hill station. One resident lives 1.2 km (0.75 mi) from BART, whereas the other lives 0.8 km (0.5 mi) away.

The logarithmic regression results in Table 1 indicate that moving 0.4 km (0.25 mi) closer to the Pleasant Hill BART station results in \$18,000 in added property values, holding all other property characteristics constant [proximity coefficient implies moving 33 percent closer results in a 7.26 percent value premium ( $-0.33 \times -0.22$ )]. The \$18,000 in property value leads to about \$130/month in additional mortgage costs at 8 percent interest for 30 years. This is the observed monthly willingness to pay to live 0.4 km (0.25 mi) closer to transit.

The walking time for a 0.4-km (0.25-mi) trip is about 5 min (4). At that rate, the resident 0.4 km closer to transit saves about 10 min/day (two trips) or about 3.3 hr/month (20 travel days). Even at an upper bound estimate for value of time of around \$20/hr for time savings (5), a resident would be willing to pay only \$66/month for the time savings of living 0.4 km closer to transit. This is only 50 percent of the observed willingness to pay.

In fact, the value of time would need to be about \$40/hr, higher than nearly every estimate found in the literature for intraurban commuting trips (6). Therefore, the observed willingness to pay for transit station proximity most likely includes nonuser benefits from proximity to transit. These nonuser benefits likely amount to at least 50 percent of the observed property value premium, since many, if not most, residents in the station area do not use BART yet pay the property value premium.

### New York City—Queens MTA Study

#### Model Specification

The hedonic approach specifies a regression equation to isolate the effect of walking distance to transit on property values. This regression explains about 42 percent of the variation in home values in the sample. The model estimated here has the following form:

$$\text{HomeVal} = \alpha + \beta_1 \text{Dist\_to\_Sta} + \beta_2 \text{Dist\_to\_Hwy} + \beta_3 \text{LotSize} + \beta_4 \text{ForestH} + \beta_5 \text{Income} + \text{error} \quad (3)$$

where

- HomeVal = assessed value of the home in 1995,
- $\alpha$  = regression constant,
- Dist\_to\_Sta = walking distance from the home to the transit station (ft),
- Dist\_to\_Hwy = physical distance from the home to the nearest freeway (ft),
- LotSize = size of the lot (ft<sup>2</sup>),
- ForestH = 1 if home is in Forest Hills and 0 otherwise, and
- Income = median income of residents in the same census block (dollars).

### Analysis of the New York Results

The results for these station areas show high levels of benefits for residents within walking distance. On average, home prices decline by about \$75 for every meter (\$23 for every foot) further from the subway stations (see Table 2). This value represents the average willingness to pay for proximity to these subway stations. The value of an average home within these subway station areas is about \$37,000 greater (13 percent premium) than a home just outside the station areas because of proximity to the subway.

These results confirm and mirror the results from Pleasant Hill near San Francisco. The same analysis of the existence of nonuser benefits holds in this case. As a percentage of home values, the benefits of transit station proximity are nearly the same for the Queens subway stations and the Pleasant Hill BART station. Time savings, again, account for at most 50 percent of the total benefits of transit station proximity measured in this study (details of this calculation are available from the authors).

### MAX—Portland East End Study

#### Model Specification

The hedonic approach specifies a regression equation to isolate the effect of walking distance to transit on property values. The model estimated here has the following form:

$$\text{HomeVal} = \alpha + \beta_1 \text{Dist} + \beta_2 \text{HomeSize} + \beta_3 \text{LotSize} + \beta_4 \text{Zoning} + \beta_5 \text{HomeAge} + \text{error} \quad (4)$$

where

- HomeVal = assessed value of the home in 1995,
- $\alpha$  = regression constant,
- Dist = walking distance from the home to the transit station (ft),
- HomeSize = size of the home (ft<sup>2</sup>),
- LotSize = size of the lot (ft<sup>2</sup>),
- Zoning = 1 for residential zoning and 0 otherwise, and
- HomeAge = age of the home (years).

Results from hedonic analysis of Portland, Oregon, light rail transit station areas were problematic, with the initial sample providing results contrary to expectations. The results are presented in Table 3.

### Analysis of Portland Results

A number of factors specific to the Portland area and data set help to explain the anomalous results and, in fact, suggest some interesting implications for getting the highest value out of transit. One explanation is that light rail vehicles are slow and have less capacity compared with heavy rail transit. The service characteristics of light rail are far below the service characteristics of most heavy rail systems, leading to the expectation that the property value effects will be weaker than for a heavy rail transit system.

One interesting and testable explanation is that the effects of transit proximity and highway proximity are conflicting in the Portland data. As the BART study showed, proximity to a highway is strongly negative for property values. Portland's light rail line runs

TABLE 2 Regression Results for Queens Stations

<i>Dependent Variable: Home Sale Price in 1996 Dollars</i>	
Variable	Linear Model Coefficient (t-statistic)
Constant	103,747 (5.81)
<u>Home and Demographic Characteristics</u>	
Lot Size	48.08 (21.03)
Forest Hills Indicator	28,992.27 (2.607)
Median Income	1.89 (5.299)
<u>Transportation Characteristics</u>	
Distance to Station	-23.49 (-7.023)
Distance to Highway	5.93 (3.034)
<u>Summary Statistics</u>	
Number of Observations	1738
R <sup>2</sup>	.424
White Heteroskedasticity Test	5.80 (pr.=0.0000)
Mean Dependent Variable	293,076.1
F - Statistic	254.73

down a major arterial street, implying that the negative effects of proximity to heavy traffic could conflict with the positive effects of the light rail transit line.

This hypothesis was tested by looking for positive transit access effects further from the light rail stations. Regressions were run restricting the data set to properties successively further from the transit stations and the major roadway. The results suggest that tran-

sit access increases property values as long as properties are within 1.6 km (1 mi) but more than 610 m (2,000 ft) from the major roadway and transit line. The sign on the distance to transit variable becomes negative when only properties more than 610 m from transit and the major roadway are included in the sample. In fact, the coefficient on distance to transit becomes significant only when properties beyond 762 m (2,500 ft) are included. Table 4 presents results for Portland for properties more than 762 m from the light rail station and major roadway.

The results of the distance-restricted regression (see Table 4) indicate that property values decline as distance to light rail increases within the included sample. However, the size of the estimated coefficient suggests a much smaller property value effect in Portland than for BART or MTA. This is probably the result of lower performance service in Portland and the lower property values generally in the Portland region compared with San Francisco and New York City.

The coefficient on the distance variable suggests that property values increase by about \$2.49 for every meter (\$0.76 for every foot) closer to light rail within the 762- to 1609-m (2,500- to 5,280-ft) distance to transit range included in the sample. Controlling for all other variables, homes 305 m (1,000 ft) closer to transit are worth about \$760 more than other homes, on average. While statistically significant, this property value premium is small compared with the results from San Francisco.

#### Previous Studies in Portland

The results of this study are somewhat contrary to results found by Al-Mosaind et al. (7). This study focused on the same station areas along the Burnside Corridor that were included here. The authors found a statistically insignificant property value premium for station

TABLE 3 Results for Portland, Oregon, Transit Station Areas

<i>Dependent Variable: Assessed Property Values, 1994</i>	
Variable	Linear Model Coefficient (t-statistic)
Constant	41431.83 (26.54)
<u>Home Characteristics</u>	
Age of Home	-506.47 (-27.44)
Size of Home	39.74 (77.7)
Lot Size	4.59 (31.0)
Residential Zoning (1 = Yes)	2777.84 (2.41)
<u>Transportation Characteristics</u>	
Distance to Light Rail	1.41 (7.48)
All coefficients are significant at the one percent level	
<u>Summary Statistics</u>	
Number of Observations	4,170
R <sup>2</sup>	.689
Mean Dependent Variable	93,211.54
White's Heteroskedasticity Test	22.1821 (pr. = 0.000)
F - Statistic	1548.65

TABLE 4 Results for Portland Station Area—Distances More Than 762 m (2,500 ft)

<i>Dependent Variable: Assessed Property Values, 1994</i>	
Variable	Linear Model Coefficient (t-statistic)
Constant	49924.61 (18.02)
<u>Home Characteristics</u>	
Age of Home	-477.47 (-20.16)
Size of Home	40.04 (61.55)
Lot Size	4.35 (21.49)
Residential Zoning (1 = Yes)	2567.98 (1.27)
<u>Transportation Characteristics</u>	
Distance to Light Rail	-.757 (-2.00)
All coefficients are significant at the five percent level	
<u>Summary Statistics</u>	
Number of Observations	2,660
R <sup>2</sup>	.690
Mean Dependent Variable	94,792.71
White's Heteroskedasticity Test	30.340 (pr. = 0.000)
F - Statistic	987.04

proximity, whereas our study found a statistically significant negative effect of station proximity in a similar regression.

The authors did find a statistically significant estimate of a property value premium for properties within 500 m of the transit station. This result could not be directly compared to the HLB study since no data were collected outside the station areas. The Al-Mosaind et al. results, while finding a positive relationship between property values and station proximity, indicate that the property value effects are minor for these stations and far smaller than the HLB results for the San Francisco area and Queens transit stations.

## POLICY IMPLICATIONS

The results of the Pleasant Hill hedonic study suggest that transit access provides large and measurable benefits to residents near the BART station. These benefits may include nonuser benefits from transit proximity. The benefits are evidenced by comparing the observed time saving and the observed willingness to pay to live closer to the transit station. The analysis suggests that nonuser benefits may account for up to 50 percent of the observed property value premium.

The immediate result of the Portland regression is that not all transit stations provide the same benefits. The results from BART and MTA suggest strong property value benefits from transit, whereas Portland only indicates small benefits to properties more than 0.8 km (0.5 mi) from transit. The BART station at Pleasant Hill is located near where the transit line breaks away from the freeway right-of-way, providing distinct data for distance to freeway and distance to BART. The New York MTA stations are subways with independent rights-of-way, providing distinct data on distance to major roadways. Portland light rail, running down the major roadway in the station area, provides no such opportunity.

These results suggest that building transit lines on freeway or major road rights-of-way sacrifices the neighborhood livability benefits of transit. Transit systems built along freeways will most likely

produce the transportation user benefits normally associated with transportation investments. However, the results of this study suggest that high-quality heavy rail transit, integrated into the structure of a neighborhood and outside the negative effect areas of major freeways, can provide benefits in excess of the transportation user benefits.

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## REFERENCES

1. Landis, J., et al. *Rail Transit Investments, Real Estate Values, and Land Use Change: A Comparative Analysis of Five California Rail Transit Systems*. Institute of Urban and Regional Development, University of California at Berkeley, Berkeley, July 1995.
2. Pushkarev, B., and J. Zupan. *Urban Rail in America: An Exploration of Criteria for Fixed-Guideway Transit*. U.S. Department of Transportation, 1980.
3. Maddala, G. S. *Econometrics*. McGraw-Hill, Inc., Tokyo, 1983.
4. *Characteristics of Urban Transportation Demand: An Update*. U.S. Department of Transportation, 1988.
5. *Research Strategies for Improving Highway User Cost Estimating Methodologies*. National Cooperative Highway Research Program, 1992.
6. Button, K. J. *Transport Economics*. University Press, Cambridge, 1993.
7. Al-Mosaind, M. A., K. J. Dueker, and J. G. Strathman. Light-Rail Transit Stations and Property Values: A Hedonic Price Approach. In *Transportation Research Record 1400*, TRB, National Research Council, Washington, D.C., 1993, pp. 90–94.

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